Developmental Testbed Center

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Developmental Testbed Center

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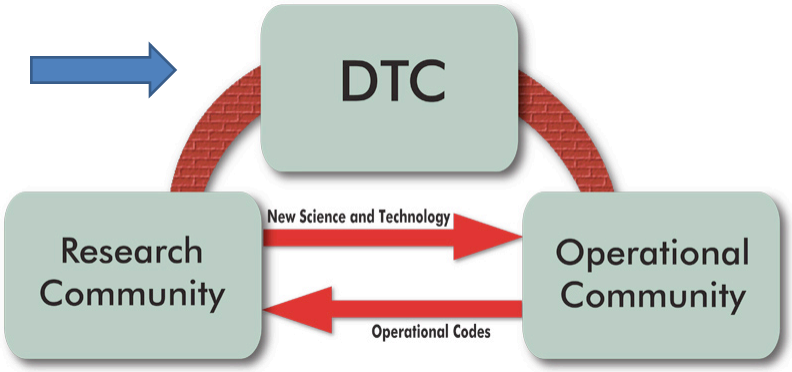
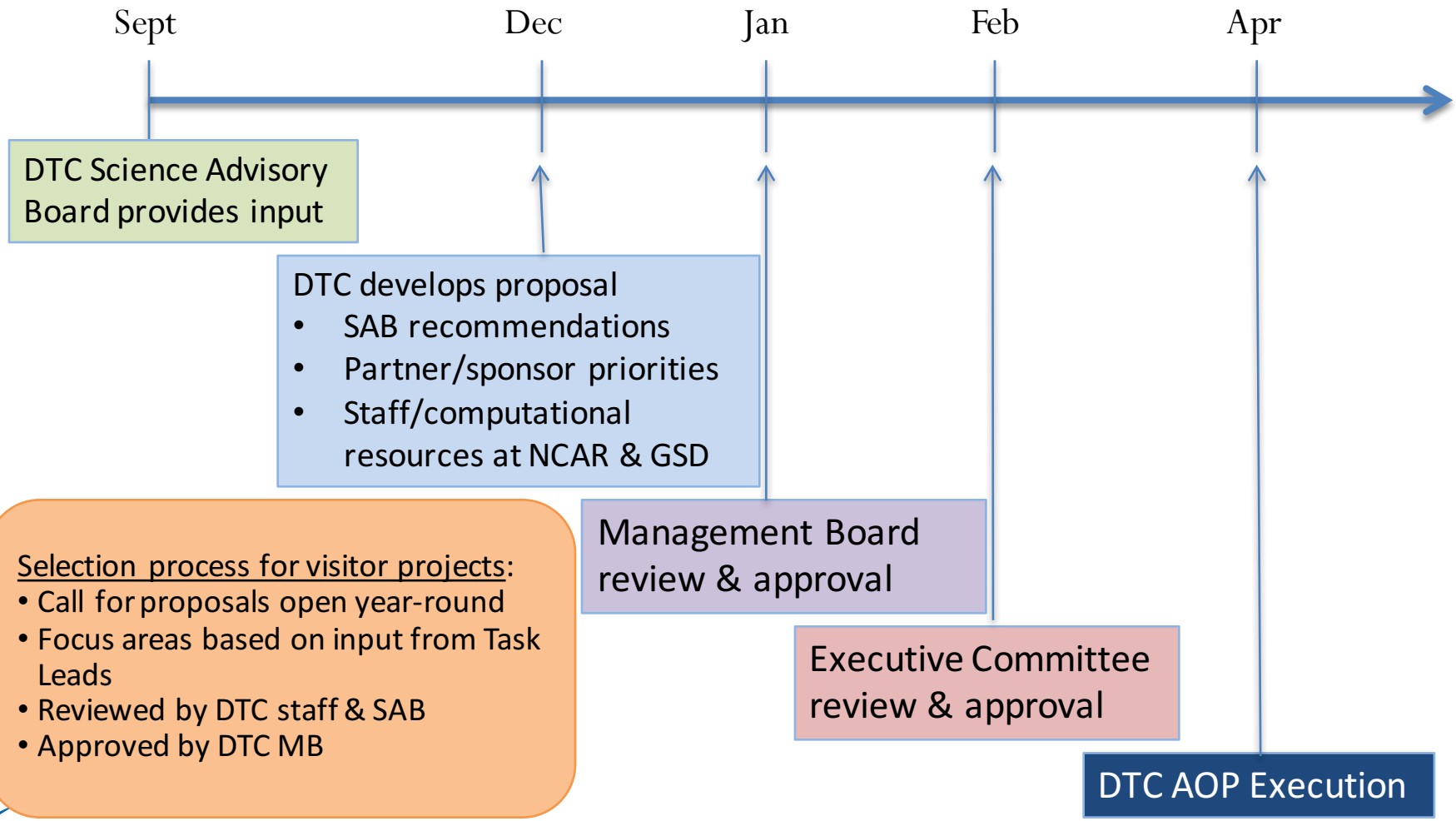
What is the DTC?

- **Purpose**: Facilitate the interaction & transition of NWP technology between research & operations
  - **O2R**: Support operational NWP systems to the community
  - **R2O**: Perform T&E on promising NWP innovations for possible operational implementation
  - **Interaction between R & O**: Workshops, Visitor Program, Newsletter
- Jointly sponsored by NOAA, Air Force, NSF, & NCAR

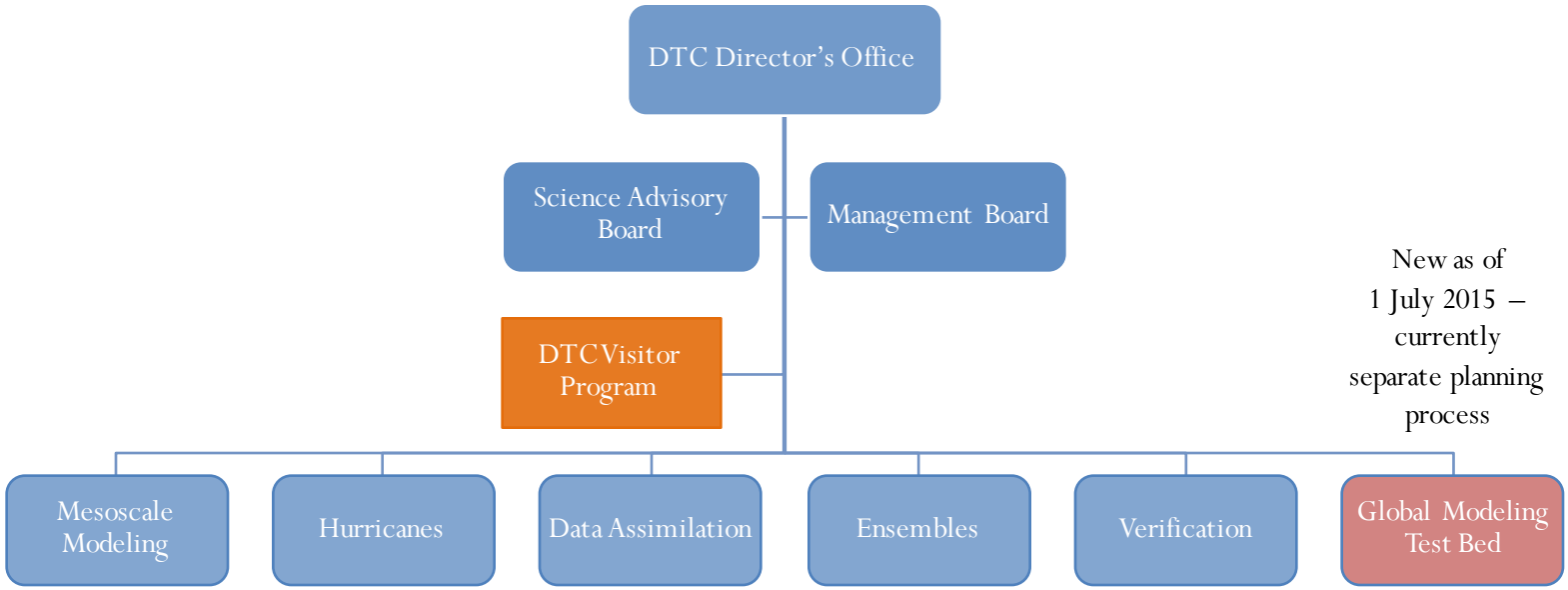
Distributed facility:
NCAR & ESRL



DTC Annual Operating Plan Process:
Period of performance: 1 April to 31 March



AOP 2015 Organization



Software Systems:
- Include capabilities of operational system
- Distributed development
- Code management plans

Verification Tools

Testing and Evaluation:
- Diagnostics of current operational systems
- Performance of new innovations

AOP 2015 Activities

Software

- NWP Information Technology Environment (NITE)
- NMMB, ARW & UPP Software Support & Community Engagement
- DA software code management and user support
- HWRF User and Developer Support
- NARRE repository maintenance and Rocoto end-to-end workflow
- Verification Outreach and Community Support for the MET System
- NOAA/NCEP Verification Community Support and Outreach
- Proto-type cloud-centric NWP index
- Common Community Physics Package (CCPP)/Interoperable Physic Driver (IPD) – including Physics Testbed

Carry-over activities

- Integration of Basinscale in HWRF

Testing and Evaluation

- Mesoscale Model Evaluation Testbed
- NAMRR system setup
- HRRR Enhancements
- Regional ensemble-based (and hybrid) DA
- HWRF physics advancement
- Stochastic physics for use in NARRE

Carry-over activities

- WRF for AFW – PBL
- NMMB – Thompson microphysics for NAM
- GSI-hybrid for HWRF application
- Evaluation of HWRF QPF
- Tropical cyclone RI/RW verification: method and application
- Neural Network Technique
- Pre-NARRE

Community Outreach: Co-sponsor WRF Users Workshop, Visitor Program, Community Sea Ice Model Workshop

AOP 2015 Activities

Highlights

Software

- NWP Information Technology Environment (NITE)
- NMMB, ARW & UPP Software Support & Community Engagement
- DA software code management and user support
- HWR
- NARR end-to-end w
- Verific ort for the MET
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- Proto-type cloud-centric NWP index
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Capability advances

Testing and Evaluation

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Carry-over activities

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Red text - community contributions

Work towards advancing capabilities

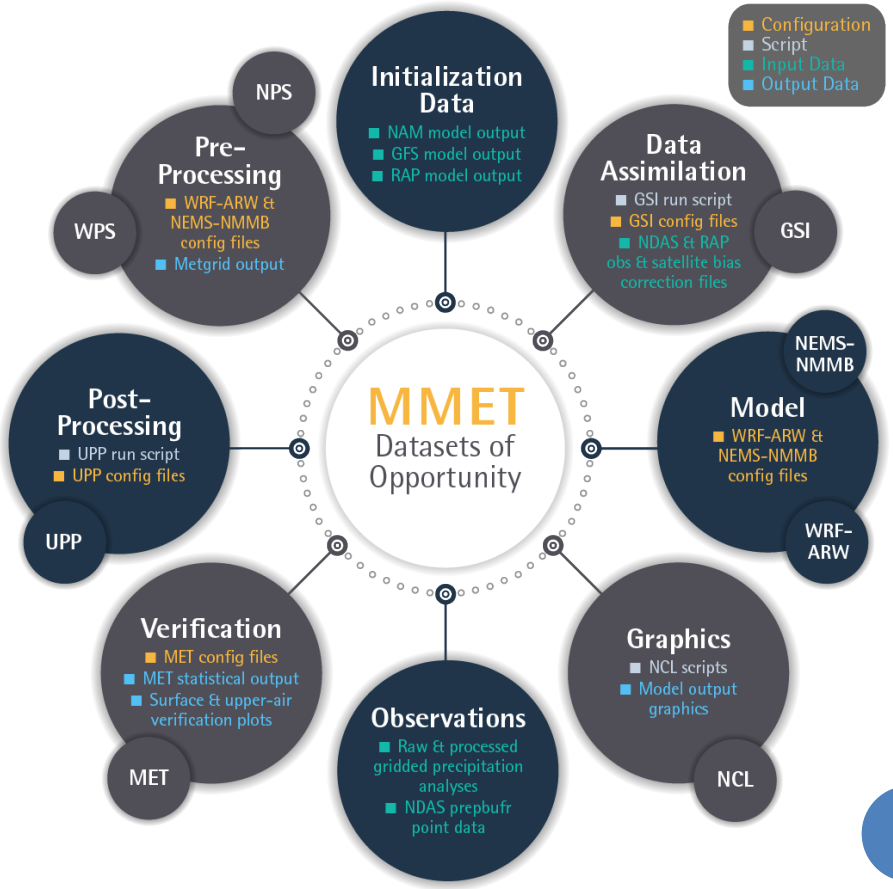
- GSI/EnKF
  - New multiple-platform compilation tool using Autotools (in progress)
  - Observation operator for aerosols (PM2.5 & PM10)
  - Interface for WRF-Chem & CMAQ background (in progress)
  - Update to Aerosol Optical Depth capability
  - Hybrid 4D EnVar function for ARW (RAP)
- NMMB
  - RUC LSM (in progress)
  - Capability to run Thompson aerosol-aware scheme (in progress)
- WRF
  - Smoothed terrain-following vertical coordinate for ARW (in progress)
- HWRF
  - Multi-storm configuration
  - Implementation of aerosol-aware RRTMG and Thompson schemes for NMM-E
- UPP
  - GRIB2 output capability (helped with testing and issues, wrote documentation)
- MET
  - MODE Time Domain
  - Regridding tool
  - Grid-shift/masking tools for storm-centric evaluations
  - Statistics based on GSI diagnostic files

Facilitating R2O using Mesoscale Model Evaluation Testbed (MMET)

Stage I: Proving ground for research community

Stage II: Extensive T&E by the DTC or community

Stage III: Pre-implementation testing at Operational Center

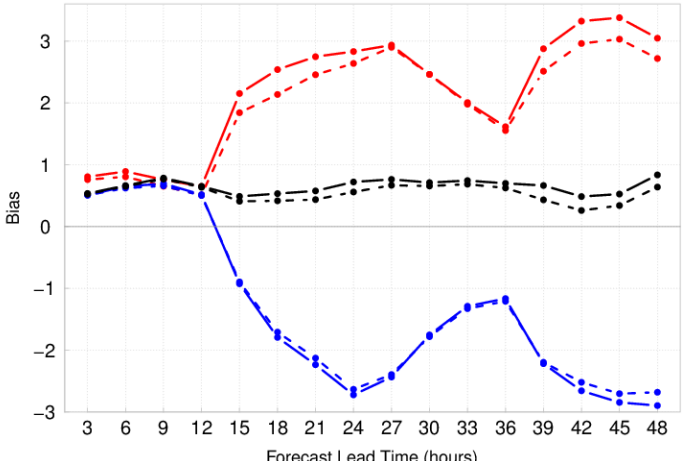


http://www.dtcenter.org/eval/meso_mod/mmet/index.php

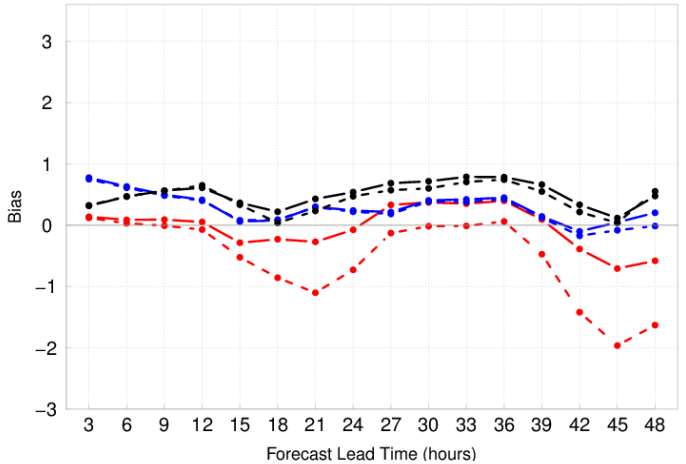
Stage I: Utilizing MMET in R2O transition

- Identify persistent operational model shortfalls
  - Surface daytime temperature biases: Warm in summer; cold in winter
- Identify new approaches that may help alleviate the problem
  - Thompson MP recently ported to NEMS/NMMB code base; directly coupled with RRTMG radiation
- Perform case study testing to investigate the impacts

Summer case: 00 UTC 11 Sep 2013



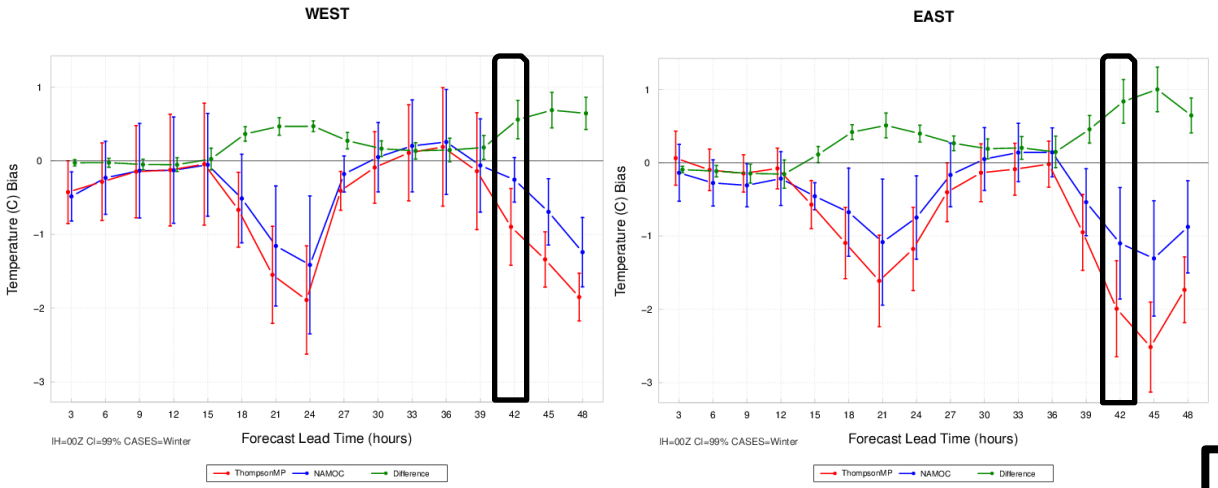
Winter case: 00 UTC 03 Feb 2012

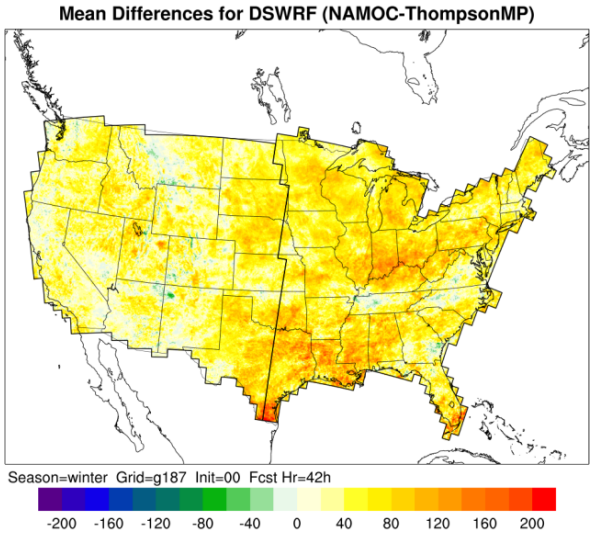


NAMps Sfc Temperature (C)
THOMps Sfc Temperature (C)
NAMps Sfc Dew Point Temperature(C)
THOMps Sfc Dew Point Temperature (C)
NAMps Sfc Wind Speed (m/s)
THOMps Sfc Wind Speed (m/s)

Stage II/III: Extended T&E leading to operational impact

Winter





NAMOC – ThompsonMP
Diff > 0 → NAMOC has larger values
Diff < 0 → ThompsonMP has larger values

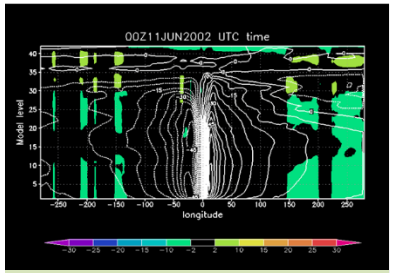
- Results shared with developers
  - NAMOC had higher surface shortwave radiation values than ThompsonMP
  - Correspond to regional point verification
    - Thompson generally colder than NAMOC, regardless of season
- Based on results from DTC extended T&E and parallel runs conducted by EMC:
  - Removed the lower limit for cloud droplet effective radius in RRTMG with the Ferrier-Aligo microphysics scheme
  - Implementing a partial cloudiness scheme to better represent subgrid scale clouds
- Both modifications are expected to improve surface shortwave radiation fluxes leading to improved surface temperature forecasts

DTC's role in HWRF development: connecting the pieces

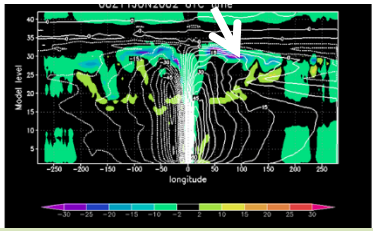
Forecast improvement

2015 HWRF implementation

Cloud top cooling due to radiation



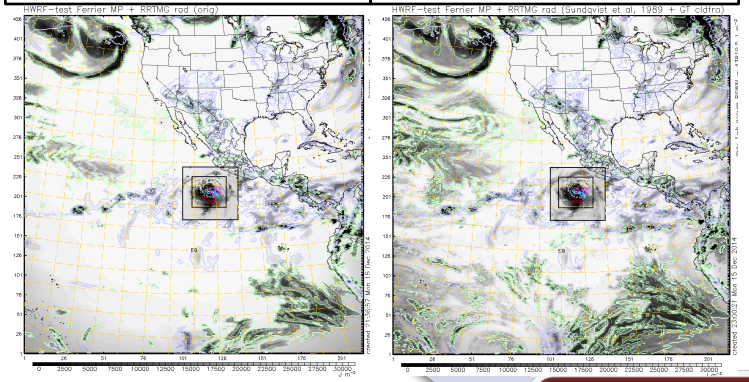
GFDL radiation



RRTMG radiation

EMC tested partial cloudiness together with other innovations

RRTMG old	RRTMG+partial cld



DTC/EMC tested RRTMG scheme

Forecast degradation

Outcome of DTC AOP 2015 T&E

Activity	Status	Outcome
NMMBT&E – Thompson microphysics	Complete	Mixed results – alternative physics not implemented but test results were used to infom a change to the operational physics suite
WRF for AFW – PBL	Complete	Mixed results – not moved to next level of testing due to AF decision to adopt UKMet Office UM model
Evaluation of HWRF QPF	Complete	Tools & results provide useful information for future development
Tropical cyclone RI/RW	Complete	Tools & results provide useful information for future development
Neural network	Complete	Provided datasets for technique development to EMC
Pre-NARRE	Complete	Encouraging results, but not moved to next level of testing due to changes to EMC's ensemble system roadmap
Regional-ensemble-based (& hybrid) DA – 13 km	Report in May	Results encouraging enough for DTC MB to recommend continued testing at 3 km (more info: Hui Shao at 3:40 pm)
HWRF physics advancement	Report in May	Mixed results from Thompson microphysics – investigating refinements of scheme + partial cloudiness for further testing
Stochastic physics for use in NARRE – 13 km	Report in April	Results encouraging enough for DTC MB to recommend continued testing for next generation ensemble system at 3 km (more info: Isidora Jankov at 2 pm)
HRRR enhancements	4 month delay	TBD

Reporting to partners/community

- DTC website (http://www.dtcenter.org/)
  - Detailed reports for all T&E activities, providing information on test configuration and extensive verification results (also sent directly to relevant partners)
  - DTC visitor project reports
  - Annual AOP reports
  - Quarterly DTC Newsletter
- Reports to sponsors
- Publications
  - Newman, K. M., C. S. Schwartz, Z. Liu, H. Shao, and X.-Y. Huang, 2015: Evaluating Forecast Impact of Assimilating Microwave Humidity Sensor (MHS) Radiances with a Regional Ensemble Kalman Filter Data Assimilation System. *Wea. Forecasting*, **30**, 964-983.
  - Bernardet, L. and coauthors, 2015. Community support and transition of research to operattons for the Hurricane Weather Research and Forecasting Model. *Bull. Amer. Meteor. Soc.*, **96**, 953-960.
  - Tallapragada, V., L. Bernardet, M. K. Biswas, I. Ginis, Y. Kwon, Q. Liu, T. Marchok, D. Sheinin, B. Thomas, M. Tong, S. Trahan, W. Wang, R. Yablonsky, X. Zhang, 2016: Hurricane Weather Research and Forecasting (HWRF) Model: 2015 Scientific Documentation. NCAR Technical Note NCAR/522+STR, 116 pp.
  - Shao, H. and coauthors, 2016: Bridging Research to Operations Transitions: Status and Plans for Community GSI. *Bull. Amer. Meteor. Soc.,* doi:10.1175/BAMS-D-13-00245.1, in press.
  - Wolff, J. K., M. Harrold, T. Hertneky, E. Aligo, J. Carley, B. Ferrier, G. DiMego, L. Nance, and Y.-H. Kuo, 2016: Mesoscale Model Evaluation Testbed (MMET): A resource for transitioning NWP innovations from Research to Operations (R2O). *Bull. Amer. Meteor. Soc.*, accepted.

AOP 2016 Activities

Highlights

Software

- NEMS, ARW & UPP Software Support & Community Engagement
- Containers for UPP, MET, and MMET datasets
- DA software code management and user support
- HWRF User and Developer Support
- HRRR ensemble code maintenance and Rocoto end-to-end workflow
- MET development and community support
- NOAA-DTC verification unification
- Cloud verification
- Common Community Physics Package (CCPP)/Interoperable Physic Driver (IPD) – including Physics Testbed

Testing and Evaluation

- Mesoscale Model Evaluation Testbed
- Addressing model uncertainty through stochastic parameter perturbations within the HRRR ensemble
- ARW smoothed terrain-following vertical coordinate
- High resolution (3 km) EnVar
- HWRF physics advancement
- Sea Ice Model
- NGGPS physics

Carry-over activities

- HRRR enhancements
- Regional ensemble-based (and hybrid) DA (13 km)
- Stochastic physics for use in NARRE

Community Outreach: Co-sponsor WRF Users Workshop, 7th Ensemble User's Workshop, Visitor Program, NGGPS Physics PI Workshop

NOAA-DTC verification unification

- Activity Description
  - Planning for unification
  - Make in-roads into unifying verification between NOAA and DTC
  - Training and support to help NOAA staff adopt MET

    NOTE: *Subset of NGGPS V&V Team workplan*
- Deliverables
  - 2-3 critical capabilities added to MET
  - Enhanced user interface and recommendations on database design to handle initial requirements for an operational installation at NCEP
  - Prioritized user support for NOAA staff
  - Development of MET/METViewer expertise at ESRL/GSD and NCEP/EMC to enable contributions from these organizations to MET/METViewer development and support
  - White Paper on roadmap for verification unification

HWRF physics advancement

- Activity description
  - Focus on model agnostic findings that translate to HWRF skill improvements
    - Explore direct and indirect role of physics in model skill and gain better understanding of how and why model physics alterations act to change tropical cyclone structure, motion, and intensity
  - Work with subject-area-experts to pursue physical process diagnostics directed at improving the representation of physical process
    - Multiple paths forward based on outcome of current test, EMC priorities, and projects funded through DTC Visitor Program
    - Microphysics and radiation, planetary boundary layer and surface layer
    - Partner with DTC visitors (demonstrated past success)
      - M. Iacono (AER), R. Fovell (U. Albany)
- Deliverables
  - Physics diagnostic tools for any modeling framework
  - Assessment of improved parameterizations with new capabilities made available to EMC for testing
  - Results presented at relevant conferences/workshops; Publication in referred journal


THANK
YOU!
http://www.dtcenter.org/